

We claim:

1. An exercise apparatus comprising:
  - a frame;
  - a pivot axle supported by said frame;
  - a pedal lever;
  - a pedal, having a toe portion and a heel portion, secured to a central portion of said pedal lever;
  - a reciprocating guide mechanism coupled to a first portion of said pedal lever effective to guide said first portion of said pedal lever in a generally horizontal reciprocating motion;
  - a crank rotationally connected to said pivot axle; and
  - an attachment assembly including a first link having a first portion pivotally attached to the end of said crank and a second portion attached to a second portion of said pedal lever wherein said attachment assembly is effective to move said second portion of said pedal lever in a non-circular, horizontal and vertical path as said crank rotates about said pivot axle resulting in said pedal moving in a generally elliptical path; and
  - a stride adjustment mechanism operatively associated with said first link effective to move at least a portion of said first link with respect to said crank thereby being effective to lengthen the horizontal portion of said elliptical path.
2. The apparatus of Claim 1 wherein said second portion of said first link is pivotally connected to said second portion of said pedal lever and said stride adjustment mechanism includes an actuator for extending the length of said first link.
3. The apparatus of Claim 1 wherein said crank includes a roller that abuts said pedal lever thereby permitting horizontal movement of said pedal lever with respect to said end of said crank and wherein said stride adjustment mechanism includes an actuator for moving said first portion of said first link linearly with respect to said crank.
4. The apparatus of Claim 1 wherein the apparatus includes a user input system and a control system operatively connected to said user input system and wherein said stride adjustment mechanism includes an actuator operatively connected to said control system for moving said first link in response to stride signals from said user input system.
5. The apparatus of Claim 5 wherein the apparatus additionally includes a speed sensor operatively connected to said control system for sensing the speed of movement of said

pedal and wherein said control system is effective to cause said stride adjustment mechanism to lengthen the horizontal portion of said elliptical path with an increase in said pedal speed.

6. An exercise apparatus comprising:

- a frame;
- a pedal lever;
- a pedal, having a toe portion and a heel portion, secured to said pedal lever;
- a guide mechanism coupled to a first portion of said pedal lever effective to guide a first portion of said pedal lever in a generally horizontal reciprocating motion;
- a pivot axle supported by said frame;
- a crank rotationally connected to said pivot axle;
- an attachment assembly operatively connected to said crank and a second portion of said pedal lever wherein said attachment assembly is effective to move said second portion of said pedal lever in a horizontal and vertical path as said crank rotates about said pivot axle resulting in said pedal moving in a generally elliptical path; and
- a control system;
- a speed sensor operatively connected to said control system for sensing the speed of movement of said pedal; and
- a stride adjustment mechanism operatively associated with said attachment assembly and operatively connected to said control system effective to lengthen the horizontal portion of said elliptical path as a function of pedal speed.

7. The apparatus of Claim 6 wherein said stride adjustment mechanism increases said horizontal portion of said elliptical path as the speed of said pedal increases.

8. The apparatus of Claim 7 wherein said stride adjustment mechanism includes an actuator operatively connected to said control system and integrated with said crank effective to lengthen said crank in response to said increasing pedal speed.

9. The apparatus of Claim 6 wherein said attachment assembly includes a first link having a first portion pivotally attached to the end of said crank and a second portion attached to a second portion of said pedal lever and wherein said stride adjustment mechanism is operatively associated with said first link effective to move at least a portion of said first link with respect to said crank thereby being effective to lengthen the horizontal portion of said elliptical path.

10. An exercise apparatus comprising:

- a frame;

a pedal lever;  
a pedal, having a toe portion and a heel portion, secured to said pedal lever;  
a guide mechanism coupled to a first portion of said pedal lever effective to guide a first portion of said pedal lever in a generally horizontal reciprocating motion;  
a pivot axle supported by said frame;  
a crank rotationally connected to said pivot axle;  
an attachment assembly operatively connected to said crank and a second portion of said pedal lever wherein said attachment assembly is effective to move said second portion of said pedal lever in a horizontal and vertical path as said crank rotates about said pivot axle resulting in said pedal moving in a generally elliptical path; and  
a control system;  
a user input and display system, operatively connected to said control system, including a plurality of input keys to permit a user to input information into said control system and at least one display for displaying exercise data;  
a resistive force generator operatively connected to said crank and said control system for generating a resistive force to the movement of said pedal;  
a speed sensor operatively connected to said control system for sensing the speed of movement of said pedal; and  
a stride adjustment mechanism operatively associated with said attachment assembly and operatively connected to said control system effective to change the horizontal portion of said elliptical path as a function of a selected portion of said information.

11. The apparatus of Claim 10 wherein said selected portion of said information is a desired pedal speed.

12. The apparatus of Claim 10 wherein said selected portion of said information is a level of said resistive force.

13. The apparatus of Claim 10 wherein said selected portion of said information is user height.

14. The apparatus of Claim 10 wherein said selected portion of said information is user weight.

15. The apparatus of Claim 10 wherein said selected portion of said information is user height.

16. The apparatus of Claim 10 wherein said selected portion of said information is a direction of user stepping motion on said pedal wherein said horizontal portion of said elliptical

path is reduced when said direction is in a backward direction.

17. The apparatus of Claim 10 wherein said selected portion of said information is an exercise program.

18. An exercise apparatus comprising:  
a frame;  
a pedal lever;  
a pedal, having a toe portion and a heel portion, secured to said pedal lever;  
a guide mechanism coupled to a first portion of said pedal lever effective to guide a first portion of said pedal lever in a generally horizontal reciprocating motion;  
a pivot axle supported by said frame;  
a crank rotationally connected to said pivot axle;  
an attachment assembly operatively connected to said crank and a second portion of said pedal lever wherein said attachment assembly is effective to move said second portion of said pedal lever in a horizontal and vertical path as said crank rotates about said pivot axle resulting in said pedal moving in a generally elliptical path; and  
a control system;  
a user input and display system, operatively connected to said control system, including a plurality of input keys to permit a user to input information into said control system and at least one display for displaying exercise data;  
a resistive force generator operatively connected to said crank and said control system for generating a resistive force to the movement of said pedal;  
a speed sensor operatively connected to said control system for sensing the speed of movement of said pedal; and  
a stride adjustment mechanism operatively associated with said attachment assembly and operatively connected to said control system effective to change the horizontal portion of said elliptical path as a function of an apparatus operating parameter.

19. The apparatus of Claim 18 wherein said operating parameter is said pedal speed.

20. The apparatus of Claim 18 wherein said operating parameter is said resistive force.

21. The apparatus of Claim 18 wherein said operating parameter is the direction of user stepping motion on said pedal wherein said horizontal portion of said elliptical path is reduced when said direction is in a backward direction.

22. The apparatus of Claim 18 wherein said control system controls said resistive force according to an exercise program and wherein said operating parameter is the current portion of said exercise program.

23. The apparatus of Claim 18 wherein the apparatus additionally includes a user heart rate monitor and wherein said operating parameter is the user's heart rate.

24. An exercise apparatus comprising:  
a frame;  
a pedal lever;  
a pedal, having a toe portion and a heel portion, secured to said pedal lever;  
a shaft secured to said frame;  
a guide mechanism including a rocker link, pivotally coupled at a first end to a first portion of said pedal lever and connected at a second end to said shaft, effective to guide a first portion of said pedal lever in a generally horizontal reciprocating motion;  
a pivot axle supported by said frame;  
a crank rotationally connected to said pivot axle;  
an attachment assembly operatively connected to said crank and a second portion of said pedal lever wherein said attachment assembly is effective to move said second portion of said pedal lever in a horizontal and vertical path as said crank rotates about said pivot axle resulting in said pedal moving in a generally elliptical path;  
an arm handle mounted on said shaft; and  
a coupling mechanism, operatively connected to said rocker link and said arm handle, for permitting a user selectively to lock said arm handle to prevent said rotation on said shaft or to couple said arm handle to said rocker link for rotation therewith.

25. The apparatus of Claim 24 wherein said coupling mechanism includes a frame hub secured to said frame and a shaft hub secured to said rocker link and secured to said shaft for rotation therewith wherein said arm handle is selectively engaged with either said frame hub or said shaft hub.

26. The apparatus of Claim 25 wherein said coupling mechanism includes a connecting member concentric with and rotatable on said shaft and said arm handle is secured for rotation with said connecting member and wherein said connecting member includes a stop member configured for alternative engagement with said shaft hub and said frame hub.

27. The apparatus of Claim 26 wherein said coupling mechanism includes an engagement mechanism that permits the user to move said connecting member along said

shaft so that said stop member is selectively engaged with said shaft hub or said frame hub.

28. The apparatus of Claim 27 wherein said engagement mechanism includes a handwheel connected to said connecting member and threadably engaged with said shaft.

29. The apparatus of Claim 27 wherein the apparatus includes a user input system and a control system operatively connected to said user input system and wherein said engagement mechanism includes an actuator mechanism responsive to said user input system to move said connecting member longitudinally along said shaft.

30. The apparatus of Claim 29 wherein said actuator mechanism includes a worm gear threadably engaged with said shaft and a motor, operatively connected to said control system and said worm gear, wherein said motor is effective to rotate said worm gear thereby moving said connecting member along said shaft.

31. The apparatus of Claim 30 wherein said actuator mechanism includes a motor support member secured to said connecting member and said motor.

32. The apparatus of Claim 29 wherein said actuator mechanism includes an actuator support member mounted on said shaft and secured from longitudinal movement on said shaft; an actuation member threadably engaged with said connecting member; and an actuation motor operatively connected to said control system and secured to said actuator support member and engaged with said actuation member effective rotate said actuation member so as to move said connecting member longitudinally along said shaft.

33. An exercise apparatus comprising:

- a frame;
- a pedal lever;
- a pedal, having a toe portion and a heel portion, secured to said pedal lever;
- a guide mechanism including a rocker link, pivotally coupled at a first end to a first portion of said pedal lever and pivotally connected at a second end to said frame, effective to guide a first portion of said pedal lever in a generally horizontal reciprocating motion;
- a pivot axle supported by said frame;
- a crank rotationally connected to said pivot axle;
- an attachment assembly operatively connected to said crank and a second portion of said pedal lever wherein said attachment assembly is effective to move said second portion of said pedal lever in a horizontal and vertical path as said crank rotates about said pivot axle resulting in said pedal moving in a generally elliptical path;
- a control system;

a user input system, operatively connected to said control system, to permit a user to input a disconnect signal into said control system;

an arm handle pivotally mounted on said frame; and

a coupling mechanism, including an actuator assembly operatively connected to said control system, for connecting said arm handle to said rocker link for movement therewith and, in response to said disconnect signal, disconnecting said arm handle from said rocker link and locking said arm handle to prevent movement of said arm handle with respect to said frame.

34. The apparatus of Claim 33 wherein said actuator assembly includes a motor operatively connected to said control system and to a worm gear for selectively engaging said arm handle with said rocker link.

35. The apparatus of Claim 34 wherein said coupling mechanism includes a shaft secured to said frame, a frame hub secured to said frame and a shaft hub secured to said rocker link, a connecting member concentric with and rotatable on said shaft and said arm handle is secured for rotation with said connecting member and wherein said connecting member includes a stop member configured for alternative engagement with said shaft hub and said frame hub and wherein said worm gear is threadably engaged with said shaft and wherein said motor is effective to rotate said worm gear thereby moving said connecting member along said shaft.

36. The apparatus of Claim 33 wherein said actuator assembly includes an actuator motor operatively connected to said control system for selectively engaging said arm handle with said rocker link.

37. The apparatus of Claim 36 wherein said coupling mechanism includes a shaft secured to said frame, a frame hub secured to said frame and a shaft hub secured to said rocker link; a connecting member concentric with said shaft and wherein said arm handle is secured for rotation with said connecting member and wherein said connecting member includes a stop member configured for alternative engagement with said shaft hub and said frame hub and wherein said actuator assembly includes an actuator member connected to said motor and wherein said motor is mounted on said shaft and the actuator member is connected to said connecting member thereby being effective to move said connecting member longitudinally along said shaft.